MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

EET2066 – POWER TECHNOLOGY

(RE)

14 JULY 2023
9:00 am – 11:00 am
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of 3 pages excluding cover page with 4 Questions only.

2. Attempt **ALL (4)** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1 [25 marks]

(a)(i) Draw the block diagram for a power electronics system. [3 marks]

(ii) Briefly explain why *n*-type BJT is preferred over *p*-type BJT. [3 marks]

(iii) Draw the circuit symbol and device structure of Schottky diode. Provide a basic description for this semiconductor device. [7 marks]

(b) Figure 1 shows a MOSFET clamped to inductive load operating at a switching frequency of 10kHz and on state time is half of off state time. The inductance of the load is large such that the load current is constant at a value of 13A. Determine the total power dissipation occurred in the MOSFET.

[12 marks]

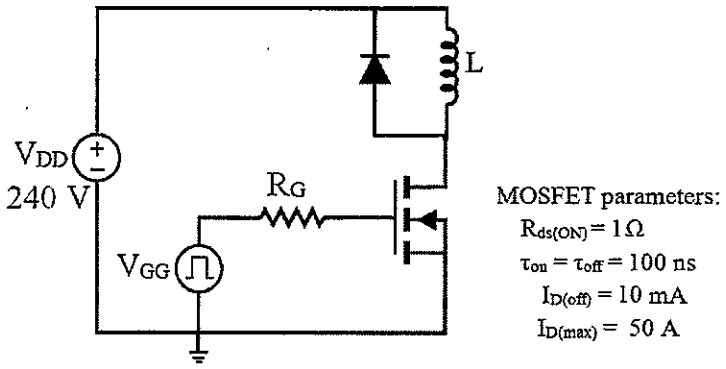

Figure 1

Continued...

Question 2 [25 marks]

(a) Briefly describe for the following terms:

(i) Commutation. [2 marks]

(ii) Natural commutation. [2 marks]

(iii) Forced commutation. [2 marks]

(iv) Extinction angle. [2 marks]

(v) Commutation overlap angle. [2 marks]

(b) The rectifier circuit in Figure 2 produces 58.828 V average output voltage.

(i) Determine for the following parameters:

1. Extinction angle (β) [2 marks]
2. RMS output voltage ($V_{o,rms}$) [3 marks]
3. Ripple voltage (V_{RL}) [2 marks]
4. Ripple voltage factor (K_v) [2 marks]

(ii) Draw following waveforms for one complete cycle:

1. Output voltage (v_o) [3 marks]
2. Diode voltage (v_D) [3 marks]

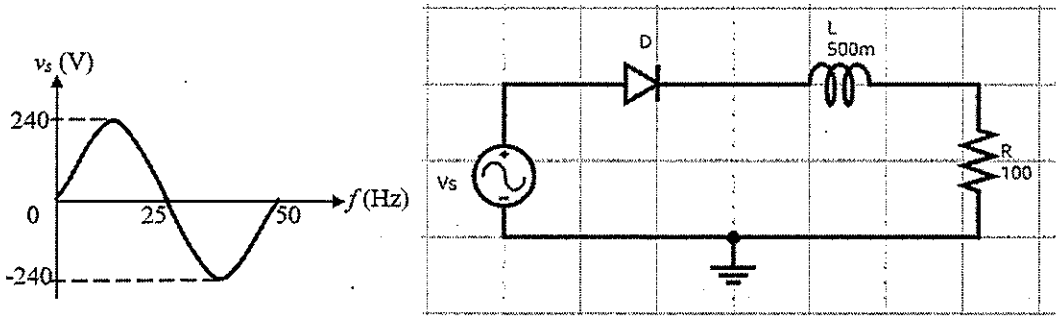

Figure 2

Continued...

Question 3 [25 marks]

A boost converter operates at 250Hz under continuous conduction mode has 25 Ω load resistance, 150 V input voltage and 12 A average load current. The load inductance limits load ripple current to 10% of I_L.

(a) Draw the circuit diagram for this converter. [3 marks]

(b) Calculate the value for output voltage and duty cycle. [4 marks]

(c) Determine the inductance value and current ratings of the inductor. [7 marks]

(d) Minimum inductance for continuous conduction mode. [3 marks]

(e) Calculate the capacitance value such that the ripple at output voltage is less than 1.5%. [2 marks]

(f) Draw the following waveforms. Clearly indicate all numerical values at the waveforms.

(i) Inductor current waveform. [3 marks]

(ii) Output voltage waveform. [3 marks]

Question 4 [25 marks]

A full bridge inverter with 120 V voltage source operating at 1.5k Hz with 60% duty cycle is connected to RL load with R=20 Ω and L=2mH. The Fourier Series expression for the instantaneous output voltage is given as:

$$v(\omega t) = \sum_{n=1,3,5...}^{\infty} \frac{4V_S}{n\pi} \sin\frac{nD\pi}{2} \cos n\left(\omega t - \frac{D\pi}{2}\right)$$

(a) (i) Draw the circuit diagram of this inverter. [3 marks]

(ii) Write the Fourier Series for the instantaneous output voltage expression up to 5th harmonics. [3 marks]

(b) Determine for the following parameters:

(i) RMS value of fundamental component ($V_{1,rms}$). [2 marks]

(ii) RMS value of total harmonic components ($V_{H,rms}$). [4 marks]

(iii) Voltage transfer ratio (T_{vv}). [2 marks]

(iv) Total harmonic distortion (THD). [3 marks]

(c) Draw the output voltage waveform and write the output voltage expression for one complete cycle. [8 marks]

End of page.